

CONTRIBUTIONS  
FROM THE  
CUSHMAN LABORATORY  
FOR  
FORAMINIFERAL RESEARCH

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VOLUME 24, PART 3

September, 1948

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# CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

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These Contributions will be issued quarterly. They will contain short papers with plates, describing new forms and other interesting notes on the general research work on the foraminifera being done on the group by the workers in this laboratory. New literature as it comes to hand will be briefly reviewed.

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# CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

## 315. *PSEUDOPARRELLA*, A NEW GENERIC NAME, AND A NEW SPECIES OF *PARRELLA*

By J. A. CUSHMAN and A. TEN DAM

The generic name *Pulvinulinella* Cushman, 1926, is preoccupied by *Pulvinulinella* Eimer and Fickert, 1899 (Zeitschr. Wiss. Zool., vol. 65, 1899, p. 700 (628)). In their paper Eimer and Fickert gave four species as belonging in their genus, the first being "*Pulvinulina auricula* Fichtel and Moll." This should be the genotype for *Pulvinulinella* Eimer and Fickert and therefore the genus is to be placed as a synonym of *Cancris*. A new name therefore is necessary for *Pulvinulinella* Cushman, 1926, and the following is proposed.

Genus **PSEUDOPARRELLA** Cushman and ten Dam, new name

Genotype, *Pulvinulinella subperuviana* Cushman

*Pulvinulinella* CUSHMAN (not EIMER and FICKERT), Contr. Cushman Lab. Foram. Res., vol. 2, pt. 3, 1926, p. 62.

*Rosalina* (part), *Rotalia* (part), *Truncatulina* (part), *Discorbina* (part), and *Pulvinulina* (part) of authors.

Test trochoid, close coiled; all chambers visible dorsally, only those of the last-formed whorl from the ventral side, very slightly if at all umbilicate; sutures on the dorsal side oblique, ventrally nearly radial; wall calcareous, perforate; aperture on the ventral side of the periphery, elongate, somewhat loop-shaped, nearly parallel to the plane of coiling.—Cretaceous to Recent.

The following species of *Parrella* seems to be new:

**PARRELLA ALGERIANA** Cushman and ten Dam, n. sp. (Pl. 9, figs. 1, 2)

Test trochoid, unequally biconvex, dorsal side slightly convex, ventral side strongly so, thinning toward the periphery which develops a wide keel of clear shell material; chambers rather indistinct, slightly inflated on the ventral side, numerous, 15 to 18 in the adult whorl, increasing very gradually and evenly in size as added; sutures rather indistinct, strongly oblique on the dorsal side, strongly curved ventrally, distinctly limbate but not raised; wall smooth; aperture ventral at the margin of the last-formed chamber toward the periphery and extending into the apertural

face at right angles to the axis of coiling. Diameter 0.90-1.35 mm.; thickness 0.40-0.70 mm.

Holotype (in ten Dam Collection) from the upper Eocene, Djebel Menaouer, south of Relizane, western Algeria. Paratypes: Cushman Coll. Nos. 57995 and 57996. It also occurs in other localities in the upper Eocene of Morocco and in the lower Oligocene.

The species resembles *Parrella bengalensis* (Schwager) but differs in the larger number of chambers and more curved ventral sutures.

### 316. A MIocene FORAMINIFERAL FAUNA FROM ECUADOR

By J. A. CUSHMAN and F. V. STEVENSON

The fauna here recorded is interesting in its relation to the faunas of other areas, particularly to those of the Miocene of California. Many of the species are identical but there are a number of undescribed ones also.

The name Charapoto formation is used here for the first time and full credit is here given to Mr. Jay Glenn Marks, formerly with the International Ecuadorian Petroleum Company and now finishing his Doctor's thesis at Stanford University, for naming the formation and collecting the samples. We also thank the International Petroleum Company, Toronto, Canada, for its permission to publish on this fauna.

The Charapoto formation consists of a relatively soft, tuffaceous shale to siltstone series, olive-green to gray on a fresh surface, somewhat argillaceous to calcareous, and light in weight. The thickness varies from 200 to 1400 meters and it weathers to gently rolling hills seldom over 200 meters in relief.

The geographic area from which the samples were collected is parallel to the west coast of Ecuador from Bahia south to the small town of Resbalon on the Rio Chico, between lat.  $0^{\circ} 30' 20''$  S. and  $1^{\circ} 4' 3''$  S. and long.  $80^{\circ} 1' 35''$  W. and  $80^{\circ} 34' 55''$  W. The following data describes the localities from which the samples were obtained:

Samples 21740, 21746, 21747, 21748, and 21749 were collected on the south side of Caraquez Bay, usually very near the railroad connecting the towns of Bahia de Caraquez and Chone.

21749-21748 - collected from 3 meter pits 8000 meters southeast of the town of Bahia de Caraquez.

21747 - collected from 3 meter pit about 50 meters west of sample locality 21748-49.

21746 - collected from surface exposure, 1250 meters west of sample locality 21748-49.

21740 - collected from surface exposure, 2500 meters west of sample locality 21748-49.

Samples 21818 and 21860 were collected south of the Caraquez Bay area.

21818 - surface collected sample 8750 meters northeast of the village of La Punta on the Pacific Coast; 7000 meters due west of the village of Los Pechiches; 20,000 meters due north of the town of Rocafuerte.

21860 - collected from 3 meter pit, 5000 meters north of the village Playa Paieta on the Rio Chico and 7750 meters southeast of the town of Rocafuerte.

A lower Miocene age is indicated for this fauna, based on field inferences and paleontology. It overlies both middle and upper Oligocene shales (Manta). It sometimes comprises the top of the section for a given area, or may be capped by still younger Miocene sediments. It is correlatable to beds in northern Ecuador which range in age from late lower Miocene to middle Miocene. In Colombia similar faunas are found in beds thought to be the same age as those in northern Ecuador or perhaps slightly younger. It would thus appear that the correlatable faunas are found stratigraphically higher as it moves northward from central western Ecuador. This fauna has not been found in Peru nor are any Venezuelan occurrences known to the authors, although it is possible that they do occur.

#### Family MILIOLIDAE

Genus *QUINQUELOCULINA* d'Orbigny, 1826

*QUINQUELOCULINA* cf. *LAEVIGATA* d'Orbigny (Pl. 9, fig. 3)

A number of small specimens from the Charapoto formation are smooth and somewhat like d'Orbigny's species but are not very well preserved.

#### Family LAGENIDAE

Genus *ROBULUS* Montfort, 1808

*ROBULUS AMERICANUS* (Cushman) (Pl. 9, fig. 4)

*Cristellaria americana* CUSHMAN, Bull. 676, U. S. Geol. Survey, 1918, p. 50, pl. 10, figs. 5, 6.

*Robulus americanus* CUSHMAN, Bull. 4, Florida State Geol. Survey, 1930, p. 24, pl. 3, fig. 7.—R. E. and K. C. STEWART, Bull. Amer. Assoc. Petr. Geol., vol. 14, 1930, p. 1448.—CUSHMAN and PONTON, Bull. 9, Florida State Geol. Survey, 1932, p. 58.—CUSHMAN and CAHILL, U. S. Geol. Survey Prof. Paper 175-A, 1933, p. 12, pl. 3, fig. 6.—KLEINPELL, Miocene Stratig. Calif., 1938, p. 196.—BANDY, Journ. Pal., vol. 18, 1944, p. 368, pl. 60, fig. 4.—CUSHMAN and RENZ, Special Publ. 22, Cushman Lab. Foram. Res., 1947, p. 12.

Specimens are common in the Charapoto formation, occurring at several localities: 21740, 21746, 21747, 21748, 21749, 21818, and 21860. Nearly all the previous records are from the Miocene.

**ROBULUS VICKSBURGENSIS (Cushman) (Pl. 9, fig. 5)**

*Cristellaria vicksburgensis* CUSHMAN, U. S. Geol. Survey Prof. Paper 129-F, 1922, p. 130, pl. 31, figs. 6, 7; Prof. Paper 133, 1923, p. 29.—APPLIN, Bull. Amer. Assoc. Petr. Geol., vol. 19, 1925, pp. 24, 25.

*Robulus vicksburgensis* ELLISOR, l. c., vol. 17, No. 11, 1933, pl. 2, fig. 2.—HOWE, Journ. Pal., vol. 16, 1942, p. 268 (list).—APPLIN and JORDAN, l. c., vol. 19, 1945, p. 130 (list).—CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 22, 1946, p. 84, pl. 14, fig. 23.—CUSHMAN and RENZ, l. c., Special Publ. 22, 1947, p. 12, pl. 3, fig. 6.—CUSHMAN and TODD, l. c., Contr., vol. 24, 1948, p. 8 (list).

Typical specimens of this Oligocene species are common in sample 21749 but were not found at the other localities.

**Genus PLANULARIA Defrance, 1824**

**PLANULARIA ARBENZI Cushman and Renz (Pl. 9, fig. 6)**

*Planularia arbenzi* CUSHMAN and RENZ, Contr. Cushman Lab. Foram. Res., vol. 17, 1941, p. 13, pl. 2, fig. 13.—CUSHMAN and ELLISOR, Journ. Pal., vol. 19, 1945, p. 553, pl. 73, fig. 5.—CUSHMAN and RENZ, Special Publ. 22, Cushman Lab. Foram. Res., 1947, p. 13, pl. 3, fig. 13.

Specimens of this species known from the Agua Salada and Ste. Croix formations of Trinidad and the Anahuac formation of Texas are common and occur in samples 21740, 21746, 21747, 21748, 21749, 21818, and 21860.

**PLANULARIA ECUADORANA Cushman and Stevenson, n. sp. (Pl. 9, figs. 7, 8)**

Test strongly compressed, the early coils visible on both sides, periphery broadly keeled, sides flattened; chambers and sutures largely obscured by the surface ornamentation which consists of usually two thick, strongly raised costae nearly parallel to the periphery, the central portion with several very irregular, high costae; aperture radiate, at the peripheral angle of the last-formed chamber. Length 0.90-1.05 mm.; breadth 0.72-0.80 mm.; thickness 0.25 mm.

Holotype (Cushman Coll. No. 57724) from the Miocene, Charapoto formation, south side of Caraquez Bay, west coast of Ecuador (sample 21747). It also occurs at locality 21748.

It differs from *P. arbenzi* Cushman and Renz in the flattened sides and very ornate surface.

**PLANULARIA CHARAPOTOA Cushman and Stevenson, n. sp. (Pl. 9, fig. 9)**

Test strongly compressed, early coils somewhat visible on both sides, periphery acute but not definitely keeled, umbonal area very slightly raised; chambers distinct, not inflated, 8 or 9 in the adult coil, increasing

very gradually in size as added; sutures distinct, not raised, very slightly curved; wall smooth; aperture radiate, at the peripheral angle of the last-formed chamber. Length 0.50-0.65 mm.; breadth 0.40-0.50 mm.; thickness 0.17 mm.

Holotype (Cushman Coll. No. 57727) from the Miocene, Charapoto formation, south side of Caraquez Bay, west coast of Ecuador (sample 21749). It is common at the type locality but was not found elsewhere.

It differs from *P. arbenzi* Cushman and Renz in the lack of a definite keel, in having the sutures flush with the surface, and a less thickened umbonal area.

**Genus DENTALINA d'Orbigny, 1826**

**DENTALINA cf. COMMUNIS d'Orbigny** (Pl. 9, fig. 10)

A few specimens similar to the one figured were found in sample 21749.

**DENTALINA sp. A.** (Pl. 9, fig. 11)

Very variable and mostly incomplete specimens of the form figured occur at localities 21746, 21747, and 21748.

**DENTALINA sp. B.** (Pl. 9, fig. 12)

Rare specimens similar to that figured were found only in sample 21818.

**Family NONIONIDAE**

**Genus NONION Montfort, 1808**

**NONION OBDUCUM** Cushman and Stevenson, n. sp. (Pl. 9, fig. 13)

Test small, planispiral, the last portion of the final coil tending slightly to uncoil, distinctly umbilicate, periphery rounded, becoming broadly so in the final portion; chambers distinct, 9-11 in the adult coil, very slightly inflated, the apertural face flattened or slightly concave; sutures distinct, curved, very slightly depressed; wall smooth; aperture a low opening at the base of the peripheral face. Length 0.30-0.40 mm.; breadth 0.25-0.30 mm.; thickness 0.20-0.25 mm.

Holotype (Cushman Coll. No. 57738) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 8750 meters northeast of the village of La Punta on the Pacific Coast, Ecuador (sample 21818). The species is common at the type locality and rare at locality 21749.

It differs from *N. soldanii* (d'Orbigny) in the much more compressed earlier stages, larger number of chambers, and high apertural face.

**NONION AGRESTUM** Cushman and Stevenson, n. sp. (Pl. 9, fig. 14)

Test small, planispiral, close-coiled, distinctly umbilicate, periphery rounded; chambers distinct, 9-11 in the adult coil, little if at all inflated, apertural face flattened; sutures fairly distinct, very slightly curved, little if at all depressed; wall smooth, coarsely perforate, often with slight projections above the umbilicus; aperture elongate, low, at the base of

the apertural face of the last-formed chamber, extending from one umbilicus to the other. Length 0.30-0.37 mm.; breadth 0.25-0.30 mm.; thickness 0.17-0.20 mm.

Holotype (Cushman Coll. No. 57741) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 8750 meters northeast of the village of La Punta on the Pacific Coast, Ecuador (sample 21818). It also occurs commonly at locality 21749.

This species differs from *N. obducum* n. sp. in being close-coiled throughout, in having the peripheral face flattened and not concave, and in the coarsely perforate wall and less expanding test.

#### **NONION COSTIFERUM (Cushman)**

*Nonionina costifera* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 90, pl. 13, fig. 2; vol. 2, pt. 3, 1926, p. 65.

*Nonion costifera* CUSHMAN and R. E. and K. C. STEWART, Trans. San Diego Soc. Nat. Hist., vol. 6, 1930, p. 60, pl. 3, fig. 13.—CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 104, pl. 11, fig. 9.—CUSHMAN and PARKER, Contr. Cushman Lab. Foram. Res., vol. 7, 1931, p. 7, pl. 1, fig. 27.—WOODRING, BRAMLETTE, and KLEINFELL, Bull. Amer. Assoc. Petr. Geol., vol. 20, 1936, p. 136 (list).—KLEINPELL, Miocene Stratig. Calif., 1938, p. 229, pl. 15, fig. 13.—CUSHMAN, U. S. Geol. Survey Prof. Paper 191, 1939, p. 15, pl. 4, fig. 5.—RENZ, Proc. 8th Amer. Sci. Congress, 1942, p. 559 (list).—CUSHMAN and R. E. and K. C. STEWART, Bull. 36, Oregon Dept. Geol. Min. Ind., pt. 2, 1947 (1948), p. 44, pl. 5, fig. 5.

This species is known from numerous localities in the Miocene of California, from the Miocene Astoria formation of Oregon, and recorded from the Miocene of Trinidad. Rare but typical specimens occur at locality 21749.

#### **Genus NONIONELLA Cushman, 1926**

**NONIONELLA ECUADORANA** Cushman and Stevenson, n. sp. (Pl. 9, fig. 15)

Test unevenly coiled in the adult, the ventral side somewhat umbilicate, the dorsal side with a prominent rounded boss in the central area, periphery rounded; chambers distinct, inflated, 10-12 in the adult coil, the ventral side much more convex than the dorsal side, increasing rather rapidly in length as added but very gradually in width; sutures deeply depressed, strongly curved; wall smooth; aperture a low opening extending from the periphery along the ventral border of the last-formed chamber. Length 0.30-0.35 mm.; breadth 0.23-0.27 mm.; thickness 0.20-0.22 mm.

Holotype (Cushman Coll. No. 57746) from the Miocene, Charapoto formation, south side of Caraquez Bay, west coast of Ecuador (sample 21749). It is common at the type locality but was not found elsewhere.

It differs from *N. miocenica* Cushman in lacking the distinct lobe on the ventral side, in being umbilicate ventrally, and in the more inflated chambers.

## FOR FORAMINIFERAL RESEARCH

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## Family HETEROHELICIDAE

## Genus PLECTOFRONDICULARIA Liebus, 1903

**PLECTOFRONDICULARIA CALIFORNICA** CUSHMAN and R. E. STEWART (Pl. 9, figs. 16, 17)

*Plectofrondicularia californica* CUSHMAN and R. E. STEWART, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 2, 1926, p. 39, pl. 6, figs. 9-11.—CHURCH, Journ. Pal., vol. 1, 1928, p. 268.—NUTTALL, Quart. Journ. Geol. Soc., vol. 84, 1928, p. 92, pl. 6, fig. 9.—GALLOWAY and MORREY, Bull. Amer. Pal., vol. 15, No. 55, 1929, p. 36, pl. 5, fig. 11.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 5, 1929, p. 90, pl. 13, figs. 18, 19.—R. E. and K. C. STEWART, Bull. Amer. Assoc. Petr. Geol., vol. 14, 1930, p. 1448.—CUSHMAN and R. E. and K. C. STEWART, Trans. San Diego Soc. Nat. Hist., vol. 6, 1930, p. 63, pl. 4, figs. 3, 4.—CUSHMAN, Special Publ. 5, Cushman Lab. Foram. Res., 1933, pl. 26, figs. 24, 25.—KLEINPELL, Miocene Stratig. Calif., 1938, p. 239, pl. 4, figs. 17, 19.—CUSHMAN, Foraminifera, 3rd Ed., 1940, Key, pl. 26, figs. 24, 25.—PALMER, Mem. Soc. Cubana Hist. Nat., vol. 14, 1940, p. 293.—HANNA and HERTLEIN, Calif. Div. Mines, Bull. 118, pt. 2, 1941, p. 182, fig. 67 [plate], figs. 48, 49.—LEROUX, Journ. Pal., vol. 15, 1941, p. 623 (list).—CUSHMAN and R. E. and K. C. STEWART, Bull. 36, Oregon Dept. Geol. Min. Ind., pt. 1, 1947 (1948), p. 16, pl. 2, fig. 2.

This species is known mostly from the Miocene and Pliocene of California and Oregon with records from the Oligocene of Cuba and the Tertiary of Manta, Ecuador. Rare specimens were found in sample 21749.

**PLECTOFRONDICULARIA MIOCENICA** CUSHMAN (Pl. 9, fig. 18)

*Plectofrondicularia miocenica* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 3, 1926, p. 58, pl. 7, figs. 10, 11; pl. 8, figs. 11, 12; vol. 5, 1929, p. 92, pl. 13, fig. 20.—GALLOWAY and MORREY, Bull. Amer. Pal., vol. 15, No. 55, 1929, p. 37, pl. 5, fig. 12.—CUSHMAN and R. E. and K. C. STEWART, Trans. San Diego Soc. Nat. Hist., vol. 6, 1930, p. 63, pl. 4, fig. 9.—CUSHMAN and PARKER, Contr. Cushman Lab. Foram. Res., vol. 7, 1931, p. 8, pl. 1, fig. 28.—CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 105, pl. 11, fig. 11.—CUSHMAN, Special Publ. 5, Cushman Lab. Foram. Res., 1933, pl. 26, fig. 26.—CUSHMAN and HOBSON, I. c., Contr., vol. 11, 1935, p. 59.—KLEINPELL, Miocene Stratig. Calif., 1938, p. 240, pl. 7, fig. 12.—CUSHMAN, Foraminifera, 3rd Ed., 1940, Key, pl. 26, fig. 26.—SCHENCK and CHILDS, Stanford Univ. Publ., Univ. Ser., Geol. Sci., vol. 3, No. 2, 1942, p. 27 (list).—WEAVER, Univ. Washington Publ. Geol., vol. 6, No. 1, 1944, p. 25 (list).

The records for this species are mostly from the Miocene of California, with records from Venezuela and Manta, Ecuador. It occurs with *P. californica* Cushman and R. E. Stewart at locality 21749.

## Genus NODOGENERINA CUSHMAN, 1927

**NODOGENERINA ADVENTA** CUSHMAN and LAIMING (Pl. 10, fig. 3)

*Nodogenerina advena* CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 106, pl. 11, fig. 19.—CUSHMAN and PONTON, Bull. 9, Florida State Geol. Survey, 1932, p. 75, pl. 11, fig. 10.—BARBAT and von ESTORFF, Journ. Pal., vol. 7, 1933, p. 171, pl. 23, fig. 2.—CUSHMAN, Special Publ. 5, Cushman Lab. Foram. Res., 1933, pl. 26, fig. 38.—WOODRING, BRAMLETTE, and KLEINPELL, Bull. Amer. Assoc. Petr. Geol., vol. 20, 1936, pp. 136, 141, 144 (lists).—KLEINPELL, Miocene Stratig. Calif., 1938, p. 243, pl. 9, fig. 10.—CUSHMAN, Foraminifera, 3rd Ed., 1940, Key, pl. 26, fig. 38.—WEAVER, Univ. Washington Publ. Geol., vol. 6, No. 1, 1944, p. 24 (list).—CUSHMAN and TODD, Special

Publ. 15, Cushman Lab. Foram. Res., 1945, p. 38, pl. 6, fig. 5.—CUSHMAN and GRAY, Special Publ. 19, 1946, p. 27, pl. 5, figs. 3-6.—CUSHMAN and R. E. and K. C. STEWART, Bull. 36, Oregon Dept. Geol. Min. Ind., pt. 1, 1947 (1948), p. 16, pl. 2, figs. 5, 6.

This species was described from the Miocene of California where it is recorded from numerous localities. It is also recorded from the Miocene of Oregon, Florida, and Jamaica and the Pliocene of California. Specimens occur at localities 21740, 21746, 21747, 21748, 21749, 21818, and 21860.

#### Genus *BULIMINELLA* Cushman, 1911

##### *BULIMINELLA CURTA* Cushman (Pl. 9, fig. 21)

*Buliminella curta* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 2, 1925, p. 33, pl. 5, fig. 13; vol. 2, pt. 3, 1926, p. 55; Bull. 4, Florida State Geol. Survey, 1930, p. 43, pl. 8, fig. 4.—R. E. and K. C. STEWART, Bull. Amer. Assoc. Petr. Geol., vol. 14, 1930, p. 1448.—CUSHMAN and LAIMING (part), Journ. Pal., vol. 5, 1931, p. 106, pl. 11, fig. 16 (not fig. 15).—CUSHMAN and PONTON, Bull. 9, Florida State Geol. Survey, 1932, p. 75.—CUSHMAN and CAHILL, U. S. Geol. Survey Prof. Paper 175-A, 1933, p. 23, pl. 7, fig. 15.—CUSHMAN and LEROY, Journ. Pal., vol. 12, 1938, p. 125, pl. 22, fig. 17.—KLEINPELL, Miocene Stratig. Calif., 1938, p. 248, pl. 7, fig. 3; pl. 15, fig. 4; pl. 16, fig. 8.—ELLISOR, Bull. Amer. Assoc. Petr. Geol., vol. 24, No. 3, 1940, pl. 4, fig. 4; pl. 5, fig. 17.—WEAVER, Univ. Washington Publ. Geol., vol. 6, No. 1, 1944, p. 23 (list).—CUSHMAN and PARKER, U. S. Geol. Survey Prof. Paper 210-D, 1947, p. 64, pl. 16, fig. 22.—CUSHMAN and McCULLOCH, Allan Hancock Pacific Exped., vol. 6, No. 5, 1948, p. 235, pl. 29, fig. 1.

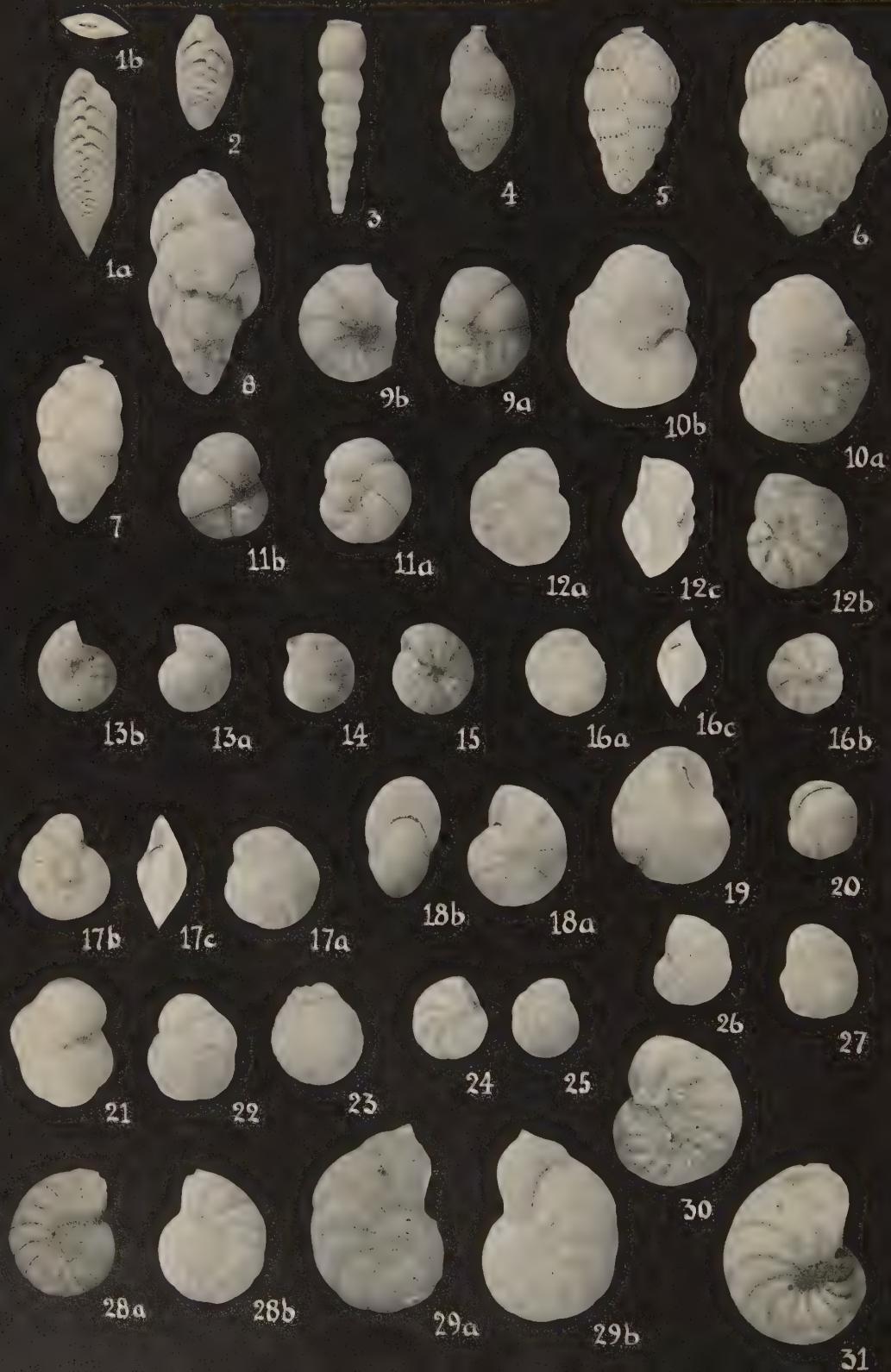
This species is widely recorded from the Miocene, particularly of the

#### EXPLANATION OF PLATE 9

Figs. 1, 2. *Parrella algeriana* Cushman and ten Dam, n. sp.  $\times 25$ . 1, Holotype, dorsal view. 2, Paratype, a, ventral view; b, peripheral view. 3. *Quinqueloculina* cf. *laevigata* d'Orbigny. 4. *Robulus americanus* (Cushman). 5. *R. vicksburgensis* (Cushman). 6. *Planularia arbenzi* Cushman and Renz. 7, 8. *P. ecuadorana* Cushman and Stevenson, n. sp. 7, Holotype. 8, Paratype. 9. *P. charapotoa* Cushman and Stevenson, n. sp. Holotype. a, side view; b, peripheral view. 10. *Dentalina* cf. *communis* d'Orbigny. 11. *Dentalina* sp. A. 12. *Dentalina* sp. B. 13. *Nonion obducum* Cushman and Stevenson, n. sp.  $\times 50$ . Holotype, a, side view; b, peripheral view. 14. *N. agrestum* Cushman and Stevenson, n. sp.  $\times 50$ . Holotype, a, side view; b, peripheral view. 15. *Nonionella ecuadorana* Cushman and Stevenson, n. sp.  $\times 50$ . Holotype, a, dorsal view; b, ventral view; c, peripheral view. 16, 17. *Plectofrondicularia californica* Cushman and R. E. Stewart. 18. *P. miocenica* Cushman. 19, 20. *Buliminella ecuadorana* Cushman and Stevenson, n. sp. 19, Holotype.  $\times 35$ . 20, Paratype, young stage.  $\times 50$ . 21. *B. curta* Cushman. 22. *Bulimina jugosa* Cushman and Parker. 23. *B. pagoda* Cushman, var. *hebespinata* R. E. and K. C. Stewart. 24. *B. uvigeriformis* Cushman and Kleinpell, var. *charapotoensis* Cushman and Stevenson, n. var. Holotype. 25, 26. *B. ecuadorana* Cushman and Stevenson, n. sp. 25, Holotype. 26, Paratype. 27, 28. *Virgulina californiensis* Cushman. 29, 30. *Bolivina interjuncta* Cushman, var. *bicostata* Cushman. 31. *B. cf. cuneiformis* Kleinpell. 32. *B. cf. alata* Seguenza. 33, 34. *B. ecuadorana* Cushman and Stevenson, n. sp. 33, Paratype, microspheric form. 34, Holotype, megalospheric form. a, front view; b, apertural view. 35. *B. dispar* Cushman and Stevenson, n. sp. Holotype, a, front view; b, apertural view. 36. *B. granti* Rankin. 37. *B. granti* Rankin, var. *denticulata* Cushman and Stevenson, n. var. Holotype.

(Unless otherwise noted, all magnifications  $\times 35$ .)





California region. It occurs commonly in the Charapoto material from localities 21740, 21746, 21747, 21748, 21749, 21818, and 21860.

**BULIMINELLA ECUADORANA Cushman and Stevenson, n. sp.** (Pl. 9, figs. 19, 20)

Test rather short, broad, greatest breadth above the middle, consisting of 3 or 4 whorls, the last-formed whorl making a large proportion of the test; chambers fairly distinct, 4 or 5 in the last-formed whorl, very slightly inflated; sutures distinct, very slightly depressed; wall smooth; aperture elongate, in a broad depression of the apertural face. Length 0.35-0.45 mm.; diameter 0.20-0.24 mm.

Holotype (Cushman Coll. No. 57760) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 5000 meters north of the village Playa Paieta on the Rio Chico, west coast of Ecuador (sample 21860). The species is common at the type locality and locality 21746 and very rare at locality 21740.

It differs from *B. brevior* Cushman from the Miocene of California in the less fusiform shape, broader apertural end, and much wider apertural face.

**Genus BULIMINA d'Orbigny, 1826**

**BULIMINA JUGOSA Cushman and Parker** (Pl. 9, fig. 22)

*Bulimina jugosa* CUSHMAN and PARKER, Contr. Cushman Lab. Foram. Res., vol. 13, 1937, p. 38, pl. 4, fig. 5; U. S. Geol. Survey Prof. Paper 210-D, 1947, p. 104, pl. 25, fig. 1.

EXPLANATION OF PLATE 10

Figs. 1, 2. *Bolivina charapotoensis* Cushman and Stevenson, n. sp. 1, Holotype, microspheric form, *a*, front view; *b*, apertural view. 2, Paratype, megalospheric form. 3. *Nodogenerina advena* Cushman and Laiming. 4. *Uvigerina charapotoensis* Cushman and Stevenson, n. sp. Holotype. 5. *Uvigerinella obesa* Cushman. 6. *Uvigerina marksi* Cushman and Stevenson, n. sp. Holotype. 7. *Uvigerinella californica* Cushman. 8. *Angulogerina charapotoensis* Cushman and Stevenson, n. sp. Holotype. 9. *Valvulinera casitasensis* Cushman and Laiming. *a*, dorsal view; *b*, ventral view. 10. *V. malagaensis* Kleinpell. *a*, dorsal view; *b*, ventral view. 11. *V. cf. chirana* Cushman and Stone. *a*, dorsal view; *b*, ventral view. 12. *V. ecuadorana* Cushman and Stevenson, n. sp. Holotype, *a*, dorsal view; *b*, ventral view; *c*, peripheral view. 13. *Gyroidea soldanii* d'Orbigny. *a*, dorsal view; *b*, ventral view. 14, 15. *G. multilocula* Coryell and Mossman. 14, Dorsal view; 15, Ventral view. 16. *Eponides ecuadorana* Cushman and Stevenson, n. sp. Holotype, *a*, dorsal view; *b*, ventral view; *c*, peripheral view. 17. *Rotalia ecuadorana* Cushman and Stevenson, n. sp. 17a, Holotype, dorsal view. 17b, *c*, Paratype, *b*, ventral view; *c*, peripheral view. 18. *Pullenia charapotoensis* Cushman and Stevenson, n. sp. Holotype, *a*, side view; *b*, apertural view. 19. *Cassidulina lomitenensis* Galloway and Wissler. Ventral view. 20. *C. delicata* Cushman. Ventral view. 21, 22. *Globorotalia praemenardii* Cushman and Stainforth. 21, Ventral view. 22, Dorsal view. 23. *Candorbolina universa* Jedlitschka. 24, 25. *Pseudoparrella subperuviana* (Cushman). 24, Ventral view. 25, Dorsal view. 26, 27. *P. thalmanni* (Stainforth and Stevenson). 26, Ventral view. 27, Dorsal view. 28. *Planulina charapotoensis* Cushman and Stevenson, n. sp. Holotype, *a*, *b*, opposite sides. 29. *P. ecuadorana* Cushman and Stevenson, n. sp. Holotype, *a*, *b*, opposite sides. 30, 31. *Cibicides isidroensis* Cushman and Renz. 30, Dorsal view. 31, Ventral view.

(Fig. 16,  $\times 50$ ; others  $\times 35$ .)

This species was described from the Tertiary of Ecuador and has not been recorded elsewhere. It is very rare at locality 21818.

**BULIMINA PAGODA** Cushman, var. **HEBESPINATA** R. E. and K. C. Stewart  
(Pl. 9, fig. 23)

*Bulimina pagoda* CUSHMAN, var. *hebespinata* R. E. and K. C. STEWART, Journ. Pal., vol. 4, 1930, p. 63, pl. 8, fig. 3.—CUSHMAN and PARKER, Contr. Cushman Lab. Foram. Res., vol. 14, 1938, p. 55, pl. 9, figs. 6, 7; U. S. Geol. Survey Prof. Paper 210-D, 1947, p. 117, pl. 27, figs. 9, 10.—CUSHMAN and McCULLOCH, Allan Hancock Pacific Exped., vol. 6, No. 5, 1948, p. 244, pl. 30, fig. 6.

The types of this variety are from the Pliocene of California and it is also recorded in samples from off the coast of southern California. Typical specimens are common at localities 21818 and 21860.

**BULIMINA UVIGERINIFORMIS** Cushman and Kleinpell,  
var. **CHARAPOTOENSIS** Cushman and Stevenson, n. var. (Pl. 9, fig. 24)

Variety differing from the typical form in the somewhat less prominent costae and the apertural end not as prominently developed.

Holotype of variety (Cushman Coll. No. 57770) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 5000 meters north of the village Playa Paieta on the Rio Chico, west coast of Ecuador (sample 21860). It is very common at the type locality and also at localities 21740 and 21749.

**BULIMINA ECUADORANA** Cushman and Stevenson, n. sp. (Pl. 9, figs. 25, 26)

Test rather rapidly tapering from the greatest breadth near the apertural end to the subacute initial end, composed of as many as 6 whorls, the last-formed one making up less than one half the length of the test; chambers rather indistinct due to the surface ornamentation; sutures somewhat indistinct, slightly depressed; wall ornamented with numerous longitudinal costae, continuing the full length of the test and somewhat anastomosing; aperture a low oval opening at the base of the apertural face and extending some distance into the face. Length 0.50-0.95 mm.; diameter 0.28-0.50 mm.

Holotype (Cushman Coll. No. 57774) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 8750 meters northeast of the village of La Punta on the Pacific Coast, Ecuador (sample 21818). It was found only at the type locality.

It differs from *B. delreyensis* Cushman and Galliher of the California Miocene in the more tapering and pointed test, higher and more prominent costae, and the last whorl making up a larger proportion of the test.

**Genus VIRGULINA d'Orbigny, 1826**

**VIRGULINA CALIFORNIENSIS** Cushman (Pl. 9, figs. 27, 28)

*Virgulina californiensis* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 2, 1925,

p. 32, pl. 5, fig. 11; vol. 2, pt. 3, 1926, p. 54.—CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 108, pl. 12, fig. 2.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 20, pl. 3, fig. 8.—BARBAT and JOHNSON, Journ. Pal., vol. 8, 1934, p. 14, pl. 1, figs. 21-24.—WOODRING, BRAMLETTE, and KLEINPELL, Bull. Amer. Assoc. Petr. Geol., vol. 20, 1936, pp. 133, 136, 141, 144, 147 (lists).—CUSHMAN, Special Publ. 9, Cushman Lab. Foram. Res., 1937, p. 20, pl. 3, figs. 10-14.—KLEINPELL, Miocene Stratig. Calif., 1938, p. 261, pl. 8, fig. 4; pl. 15, fig. 8.—HANNA and HERTLEIN, Calif. Div. Mines, Bull. 118, pt. 2, 1941, p. 180, fig. 67 [plate], fig. 19.—SCHENCK and CHILDS, Stanford Univ. Publ., Univ. Ser., Geol. Sci., vol. 3, No. 2, 1942, p. 27 (list).—WEAVER, Univ. Washington Publ. Geol., vol. 6, No. 1, 1944, p. 25 (list).—CUSHMAN and R. E. and K. C. STEWART, Bull. 36, Oregon Dept. Geol. Min. Ind., pt. 2, 1947 (1948), p. 47, pl. 6, fig. 2.

This species is widely recorded in the Miocene of California. It is very common in sample 21749 but was not found at the other localities.

#### Genus *BOLIVINA* d'Orbigny, 1839

*BOLIVINA INTERJUNCTA* Cushman, var. *BICOSTATA* Cushman (Pl. 9, figs. 29, 30)

*Bolivina costata* d'ORBIGNY, var. *bicostata* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 2, 1926, p. 42.—CUSHMAN and MOYER, I. c., vol. 6, 1930, p. 57.

*Bolivina interjuncta* CUSHMAN, var. *bicostata* CUSHMAN, Special Publ. 9, Cushman Lab. Foram. Res., 1937, p. 116, pl. 22, fig. 23.—CUSHMAN and McCULLOCH, Allan Hancock Pacific Exped., vol. 6, No. 4, 1942, p. 195, pl. 23, figs. 9-11, 13-16.—CUSHMAN and GRAY, Special Publ. 19, Cushman Lab. Foram. Res., 1946, p. 35, pl. 6, fig. 3.

This variety is known from the Pliocene of California and living off the west coast of North and South America. Typical specimens are very common in the Charapoto material, occurring at localities 21740, 21746, 21747, 21748, 21749, 21818, and 21860.

#### *BOLIVINA GRANTI* Rankin (Pl. 9, fig. 36)

*Bolivina granti* RANKIN, in CUSHMAN and KLEINPELL, Contr. Cushman Lab. Foram. Res., vol. 10, 1934, p. 21, pl. 4, figs. 2, 3.—WOODRING, BRAMLETTE, and KLEINPELL, Bull. Amer. Assoc. Petr. Geol., vol. 20, 1936, p. 144 (list).—CUSHMAN, Special Publ. 9, Cushman Lab. Foram. Res., 1937, p. 102, pl. 11, figs. 13, 14.—KLEINPELL, Miocene Stratig. Calif., 1938, p. 272.

This species has been known previously only from the Miocene of California. Specimens are common in the Charapoto material, occurring in samples 21749, 21818, and 21860.

#### *BOLIVINA GRANTI* Rankin, var. *IDENTICULATA* Cushman and Stevenson, n. var.

(Pl. 9, fig. 37)

Variety differing from the typical form in the basal ends of the chambers extending out into narrow lobular projections.

Holotype of variety (Cushman Coll. No. 57792) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 8750 meters northeast of the village of La Punta on the Pacific Coast, Ecuador (sample 21818). It is common at the type locality and also occurs at localities

21740, 21746, 21747, 21748, and 21749. In some respects it resembles *B. sinuata* Galloway and Wissler but the essential characters are those of *B. granti* Rankin.

**BOLIVINA cf. CUNEIFORMIS Kleinpell** (Pl. 9, fig. 31)

The figured specimen from sample 21818 seems closely related to this species but more specimens are needed to be certain of its specific identity.

**BOLIVINA cf. ALATA Seguenza** (Pl. 9, fig. 32)

As in the preceding case, this form is very rare but resembles Seguenza's species. It is also from sample 21818.

**BOLIVINA DISPAR Cushman and Stevenson, n. sp.** (Pl. 9, fig. 35)

Test elongate, initial end acute, rapidly increasing in width with the first few pairs of chambers, then with the sides nearly parallel, thick in the middle with the periphery in the early stages subacute, later becoming somewhat rounded; chambers distinct, little if at all inflated, numerous, as many as 16 or 18 pairs in the microspheric form, increasing very gradually in size as added; sutures distinct, somewhat limbate but not raised, very slightly curved; wall smooth, distinctly perforate; aperture elongate, very narrow, in the apertural face of the last-formed chamber with a distinct, thickened lip. Length 0.65-0.80 mm.; breadth 0.25-0.33 mm.; thickness 0.20-0.25 mm.

Holotype (Cushman Coll. No. 57801) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 5000 meters north of the village Playa Paieta on the Rio Chico, west coast of Ecuador (sample 21860). The species is abundant at the type locality and also occurs at localities 21740 and 21746.

It differs from *B. obliqua* Barbat and Johnson in its limbate sutures, more acute initial end, and lower chambers.

**BOLIVINA ECUADORANA Cushman and Stevenson, n. sp.** (Pl. 9, figs. 33, 34)

Test relatively short and broad, the microspheric form increasing rapidly in width, the megalospheric form very slowly, fairly thick in the median line, periphery subacute; chambers distinct, slightly inflated, increasing very gradually in size as added, in the last-formed ones with a slight backwardly-projecting lobe near the inner end; sutures distinct, strongly recurved toward the periphery, slightly depressed, more strongly so in the later portion; wall in the earlier stages with longitudinal costae, more numerous and held longer in the microspheric form, later portion smooth; aperture fairly broad, slightly comma-shaped, with a slight lip. Length 0.60-0.83 mm.; breadth 0.30-0.40 mm.; thickness 0.20-0.25 mm.

Holotype (Cushman Coll. No. 57805) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 5000 meters north of the vil-

lage Playa Paieta on the Rio Chico, west coast of Ecuador (sample 21860). The species is very common at the type locality but was not found elsewhere.

It differs from *B. advena* Cushman in the broader form, somewhat higher and fewer chambers, and more acute periphery.

**BOLIVINA CHARAPOTOENSIS** Cushman and Stevenson, n. sp. (Pl. 10, figs. 1, 2)

Test elongate, slender, early portion rapidly tapering, sides in the adult parallel, initial end in the microspheric form subacute, in the megaspheric form somewhat rounded, test thickened in the median line, often with a slight ridge, periphery acute, often slightly keeled; chambers distinct, but not inflated, increasing very gradually in size in the adult; sutures distinct, not depressed, strongly oblique, slightly curved; wall smooth; aperture elongate, somewhat comma-shaped. Length 0.60-0.75 mm.; breadth 0.20-0.30 mm.; thickness 0.15-0.18 mm.

Holotype (Cushman Coll. No. 57809) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 8750 meters northeast of the village of La Punta on the Pacific Coast, Ecuador (sample 21818). It is common at the type locality and also at localities 21740, 21746, 21747, 21748, and 21749.

It differs from *B. obliqua* Barbat and Johnson in its more curved sutures, acute periphery, and more tapering form.

**Genus UVIGERINELLA Cushman, 1926**

**UVIGERINELLA OBESA** Cushman (Pl. 10, fig. 5)

*Uvigerina (Uvigerinella) obesa* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 3, 1926, p. 59, pl. 8, figs. 3, 7.

*Uvigerinella obesa* CUSHMAN and PARKER, l. c., vol. 7, 1931, p. 10, pl. 2, fig. 4.—CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 111, pl. 12, fig. 10.—KLEINPELL, Miocene Stratig. Calif., 1938, p. 290, pl. 9, fig. 15.—STAINFORTH, Journ. Pal., vol. 22, 1948, p. 133, pl. 24, fig. 20.

This is a very abundant species, occurring at localities 21740, 21746, 21748, 21749, 21818, and 21860. Specimens are somewhat larger than those from the Miocene of California, in length ranging from 0.65 to 0.90 mm., and in diameter from 0.40 to 0.45 mm.

**UVIGERINELLA CALIFORNICA** Cushman (Pl. 10, fig. 7)

*Uvigerina (Uvigerinella) californica* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 3, 1926, p. 58, pl. 8, figs. 2, 5.

*Uvigerinella californica* CUSHMAN and PARKER, l. c., vol. 7, 1931, p. 10, pl. 2, fig. 3.—KLEINPELL, Miocene Stratig. Calif., 1938, p. 237, pl. 7, fig. 9; pl. 9, fig. 13.—STAINFORTH, Journ. Pal., vol. 22, 1948, p. 132, pl. 24, fig. 19.

This species occurs commonly at localities 21749 and 21860. It may be

a varietal form as some specimens are quite distinctly costate toward the initial end.

Genus UVIGERINA d'Orbigny, 1826

UVIGERINA CHARAPOTOENSIS Cushman and Stevenson, n. sp. (Pl. 10, fig. 4)

Test of medium size for the genus, fusiform, periphery lobulated; early chambers rapidly increasing in size, later chambers inflated, of about equal size or slightly decreasing; sutures distinct, deeply incised except the earlier ones; wall ornamented with numerous longitudinal costae, low, evenly spaced, sharp but not serrate, not continuous across the sutures, wall between the costae smooth and polished or finely hispid, some specimens becoming hispid toward the apertural end and lacking costae on the last several chambers; aperture circular, at the end of a short neck, surrounded by a slightly flaring lip. Length 0.50-0.65 mm.; diameter 0.28-0.42 mm.

Holotype (Cushman Coll. No. 57889) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 8750 meters northeast of the village of La Punta on the Pacific Coast, Ecuador (sample 21818). It is common at the type locality and less abundant at localities 21747 and 21860.

This species resembles *U. laviculata* Coryell and Rivero from the Miocene of Haiti but differs in that the costae are interrupted by the sutures, the chambers are more inflated, the neck is not set in a depression, as in *laviculata*, but projects from the summit of the last-formed chamber, and the whole test is much smaller. It also somewhat resembles the Recent species *U. flintii* Cushman but differs in having more inflated chambers.

UVIGERINA MARKSI Cushman and Stevenson, n. sp. (Pl. 10, fig. 6)

Test large, robust, greatest diameter about the middle, periphery lobulated; chambers few, large, inflated, rapidly increasing in size as added; sutures distinct, depressed, curved; wall ornamented with a few, low, widely spaced, longitudinal costae, not continuous across the sutures, becoming obsolete on the later chambers; aperture circular, with a prominent curved tooth, without a neck, but surrounded by a thickened rim. Length 0.75-0.95 mm.; diameter 0.55-0.65 mm.

Holotype (Cushman Coll. No. 57901) from the Miocene, Charapoto formation, south side of Caraquez Bay, west coast of Ecuador (sample 21746). It is common at this locality but was not found elsewhere.

This species differs from *U. kernensis* Barbat and von Estorff from the Miocene of California in its larger, stouter form, its lack of an apertural neck, and its lack of spinosity on the later chambers.

## Genus ANGULOGERINA Cushman, 1927

ANGULOGERINA CHARAPOTOENSIS Cushman and Stevenson, n. sp. (Pl. 10, fig. 8)

Test large for the genus, irregularly triangular but not carinate, tapering to the greatest width formed by the last whorl of chambers; chambers indistinct except the last few, irregular and undercut at their bases, not inflated; sutures deeply incised, curved and very irregular in pattern; wall thick, ornamented throughout with low, longitudinal costae, not usually continuous across the sutures, irregular in pattern and spacing, tending to disappear toward the apertural end; aperture large, circular, with a narrow, curved tooth-plate, without a neck or only a very short one, surrounded by a thickened rim. Length 0.85-1.00 mm.; breadth 0.45-0.52 mm.

Holotype (Cushman Coll. No. 57906) from the Miocene, Charapoto formation, south side of Caraquez Bay, west coast of Ecuador (sample 21746). It is abundant at the type locality and also occurs at localities 21740, 21747, 21748, 21749, and 21860.

This species differs from *A. fluens* Todd from Recent Pacific material in its larger size and the costae being not continuous across the sutures. Young specimens resemble *A. decorissima* Galloway and Heminway in shape but are much less finely costate.

## Family ROTALIIDAE

## Genus VALVULINERIA Cushman, 1926

VALVULINERIA CASITASENSIS Cushman and Laiming (Pl. 10, fig. 9)

*Valvulineria casitasensis* CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 113, pl. 13, fig. 1.—CUSHMAN, Special Publ. 5, Cushman Lab. Foram. Res., 1933, pl. 30, fig. 2.—CUSHMAN and LEROY, Journ. Pal., vol. 12, 1938, p. 125, pl. 22, fig. 21.—KLEINPELL, Miocene Stratig. Calif., 1938, p. 311.—CUSHMAN, Foraminifera, 3rd Ed., 1940, Key, pl. 30, fig. 2.—WEAVER, Univ. Washington Publ. Geol., vol. 6, No. 1, 1944, p. 25 (list).

This species has previously been known only from the Miocene of California. Specimens seemingly identical were found in sample 21740.

VALVULINERIA MALAGAENSIS Kleinpell (Pl. 10, fig. 10)

*Valvulineria araucana* (d'ORBIGNY), var. *malagaensis* KLEINPELL, Miocene Stratig. Calif., 1938, p. 308, pl. 22, figs. 10-12.

This species was described from the Miocene of California and has been recorded by LeRoy from the Miocene of Sumatra and late Miocene or early Pliocene of Siberoet Island, Dutch East Indies (Colorado School Mines Quart., vol. 36, No. 1, pt. 2, 1941, p. 83, pl. 4, figs. 22-24; vol. 39, No. 3, pt. 1, 1941, p. 33, pl. 2, figs. 46-48; pl. 6, figs. 28-30) but these do not seem entirely typical. In the Charapoto material it occurs in samples 21748, 21749, 21818, and 21860.

**VALVULINERIA cf. CHIRANA Cushman and Stone** (Pl. 10, fig. 11)

Rather rare specimens from locality 21740 somewhat resemble this species described from the Eocene, Chira shale, of Peru (Special Publ. 20, Cushman Lab. Foram. Res., 1947, p. 22, pl. 3, fig. 3).

**VALVULINERIA ECUADORANA Cushman and Stevenson, n. sp.** (Pl. 10, fig. 12)

Test plano-convex, dorsal side nearly flat, ventral side strongly convex, slightly umbilicate, periphery subacute; chambers distinct, 6 to 8 in the adult whorl, strongly inflated on the ventral side, increasing rather evenly in size as added; sutures distinct, somewhat limbate, depressed on the ventral side where they are nearly radial, strongly curved on the dorsal side; wall smooth, distinctly perforate; aperture ventral, along the border of the last-formed chamber and extending under the ventral lobe, with a very slight lip. Diameter 0.50-0.75 mm.; thickness 0.35-0.45 mm.

Holotype (Cushman Coll. No. 57834) from the Miocene, Charapoto formation, south side of Caraquez Bay, west coast of Ecuador (sample 21749). It is rather rare at the type locality and not found elsewhere.

The species differs from *V. malagaensis* Kleinpell in its plano-convex test, subacute periphery, and more curved dorsal sutures.

**Genus GYROIDINA d'Orbigny, 1826****GYROIDINA SOLDANII d'Orbigny** (Pl. 10, fig. 13)

Specimens referable to this widely recorded species occur at localities 21746, 21748, and 21860.

**GYROIDINA MULTILOCULA Coryell and Mossman** (Pl. 10, figs. 14, 15)

*Gyroidina soldanii* d'ORBIGNY, var. *multilocula* CORYELL and MOSSMAN, Journ. Pal., vol. 16, 1942, p. 237, pl. 36, fig. 20.

This was described from the Pliocene, Charco Azul formation, of Panama. Specimens apparently identical occur commonly at localities 21749, 21818, and 21860.

**Genus EPONIDES Montfort, 1808****EPONIDES ECUADORANA Cushman and Stevenson, n. sp.** (Pl. 10, fig. 16)

Test very small for the genus, strongly biconvex, whorls very narrow on the dorsal side, periphery acute; chambers distinct, very slightly if at all inflated, increasing very gradually in size as added, 7 or 8 in the adult whorl; sutures distinct, little if at all depressed, distinctly curved on the ventral side, on the dorsal side strongly oblique; wall smooth; aperture a low opening on the ventral border of the last-formed chamber. Diameter 0.22-0.25 mm.; thickness 0.15-0.17 mm.

Holotype (Cushman Coll. No. 57844) from the Miocene, Charapoto formation, south side of Caraquez Bay, west coast of Ecuador (sample 21749). It is very common at the type locality and also occurs at localities 21748 and 21818.

The species differs from *E. minima* Cushman in the more strongly biconvex test, larger number of chambers, and very narrow whorls on the dorsal side.

#### Genus ROTALIA Lamarck, 1804

**ROTALIA ECUADORANA** Cushman and Stevenson, n. sp. (Pl. 10, fig. 17)

Test biconvex, dorsal side less strongly so, periphery slightly rounded to subacute, ventral side with a large central boss; chambers fairly distinct, 8 to 10 in the adult whorl, increasing very gradually in size as added; slightly inflated on the ventral side; sutures distinct, somewhat depressed and nearly radial on the ventral side, dorsally nearly radial, not depressed; wall smooth; aperture on the ventral border of the last-formed chamber. Diameter 0.40-0.45 mm.; thickness 0.15-0.20 mm.

Holotype (Cushman Coll. No. 57849) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 8750 meters northeast of the village of La Punta on the Pacific Coast, Ecuador (sample 21818). It is fairly common at the type locality but was not found elsewhere.

It differs from *R. beccarii* (Linné) in the much more compressed test, subacute periphery, and nearly bilaterally symmetrical edge view.

#### Family CASSIDULINIDAE

##### Genus CASSIDULINA d'Orbigny, 1826

**CASSIDULINA LOMITENSIS** Galloway and Wissler (Pl. 10, fig. 19)

*Cassidulina lomitensis* GALLOWAY and WISSLER, Journ. Pal., vol. 1, 1927, p. 79, pl. 12, fig. 10.—CUSHMAN and GRAY, Special Publ. 19, Cushman Lab. Foram. Res., 1946, p. 43, pl. 7, fig. 18.—CUSHMAN and TODD, I. c., Contr., vol. 23, 1947, p. 69, pl. 16, fig. 19.

This species is known from the Pliocene and Pleistocene of California and the Pliocene? of Alaska. Specimens apparently identical occur commonly at localities 21746, 21749, and 21818.

##### **CASSIDULINA DELICATA** Cushman (Pl. 10, fig. 20)

(For references, see Special Publ. 15, Cushman Lab. Foram. Res., 1945, p. 62, pl. 10, fig. 12.)

The records for this very small species are mostly from the Late Tertiary of the Pacific area. Typical specimens are fairly common in samples 21818 and 21860.

##### Genus PSEUDOPARRELLA Cushman and ten Dam, 1948

**PSEUDOPARRELLA SUBPERUVIANA** (Cushman) (Pl. 10, figs. 24, 25)

*Pulvinulinella subperuviana* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 3, 1926, p. 63, pl. 9, fig. 9.—CUSHMAN and R. E. and K. C. STEWART, Trans. San Diego Soc. Nat. Hist., vol. 6, 1930, p. 73.—CUSHMAN, Special Publ. 4, Cushman Lab. Foram. Res., 1933, pl. 26, fig. 2.—WOODRING, BRAMLETTE, and KLEINPELL, Bull. Amer. Assoc. Petr. Geol., vol. 20, 1936, p. 133 (list).—KLEINPELL, Miocene Stratig. Calif., 1938, p. 330.—CUSHMAN, Foraminifera, 3rd Ed., 1940, pl. 26, fig. 2.

This species has been known only from the Miocene and Pliocene of California. Typical specimens occur in the Charapoto formation at localities 21747 and 21860.

**PSEUDOPARRELLA THALMANNI** (Stainforth and Stevenson) (Pl. 10, figs. 26, 27)

*Palmerinella thalmanni* STAINFORTH and STEVENSON, Journ. Pal., vol. 20, 1946, p. 563, pl. 86, figs. 7-10.—STAINFORTH, l. c., vol. 22, 1948, p. 133, pl. 25, fig. 4.

This species, described from the Miocene of Ecuador, is common in samples 21747 and 21749. A study of the types together with this large series seems to indicate that the species should be placed in *Pseudoparrella*.

Family CHILOSTOMELLIDAE

Genus PULLENIA Parker and Jones, 1862

**PULLENIA CHARAPOTOENSIS** Cushman and Stevenson, n. sp. (Pl. 10, fig. 18)

Test fairly large, periphery broadly rounded, umbilicate, apertural face flattened; chambers distinct but not inflated, typically 8 in the adult coil, increasing very gradually and evenly in size as added; sutures distinct, not depressed, slightly sinuous; wall smooth; aperture extending from one umbilicus to the other at the base of the last-formed chamber. Length 0.55-0.85 mm.; breadth 0.45-0.60 mm.; thickness 0.40-0.55 mm.

Holotype (Cushman Coll. No. 57852) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 5000 meters north of the village Playa Paieta on the Rio Chico, west coast of Ecuador (sample 21860). It is fairly common at the type locality and also occurs at localities 21747, 21748, and 21749.

It differs from *P. multilobata* Chapman in its much broader apertural face, more rounded periphery, and distinct umbilicus.

Family GLOBIGERINIDAE

There are numerous species of this family present but except for the following they are not included here.

Genus CANDORBULINA Jedlitschka, 1933

**CANDORBULINA UNIVERSA** Jedlitschka (Pl. 10, fig. 23)

The figured specimen from sample 21740 was the only one of this typically Miocene species found in the present material.

Family GLOBOROTALIIDAE

Genus GLOBOROTALIA Cushman, 1927

**GLOBOROTALIA PRAEMENARDII** Cushman and Stainforth (Pl. 10, figs. 21, 22)

*Globorotalia praemenardii* CUSHMAN and STAINFORTH, Special Publ. 14, Cushman Lab. Foram. Res., 1945, p. 70, pl. 13, fig. 14.—STAINFORTH, Journ. Pal., vol. 22, 1948, p. 121, pl. 26, figs. 34, 35.

Specimens very similar to the types from the Oligocene, Cipero formation, of Trinidad occur rather rarely at localities 21740, 21746, and 21818.

Family ANOMALINIDAE  
Genus **PLANULINA** d'Orbigny, 1826

**PLANULINA CHARAPOTOENSIS** Cushman and Stevenson, n. sp. (Pl. 10, fig. 28)

Test distinctly evolute, dorsal side flattened or even slightly concave, ventral side very slightly convex in the earlier whorls, adult ones flattened, periphery subacute; chambers distinct, slightly inflated, increasing very gradually and evenly in size as added, 12 or 13 in the adult whorl; sutures distinct, slightly depressed, strongly curved; wall smooth but very coarsely perforate; aperture a low opening at the base of the peripheral margin of the last-formed chamber. Length 0.60-0.78 mm.; breadth 0.50-0.65 mm.; thickness 0.15-0.18 mm.

Holotype (Cushman Coll. No. 57875) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 8750 meters northeast of the village of La Punta on the Pacific Coast, Ecuador (sample 21818). It is fairly common at the type locality and at locality 21749.

The species differs from *P. dohertyi* (Galloway and Morrey) in the larger number of chambers in a whorl, less curved sutures, and more evenly shaped chambers.

**PLANULINA ECUADORANA** Cushman and Stevenson, n. sp. (Pl. 10, fig. 29)

Test evolute, dorsal side flattened or slightly concave, ventral side convex, periphery subacute or slightly rounded; chambers distinct, somewhat inflated, increasing very gradually and evenly in size as added, 9 or 10 in the adult whorl; sutures distinct, somewhat depressed, slightly curved; wall smooth, distinctly perforate, aperture a low opening at the base of the peripheral margin of the last-formed chamber. Length 0.70-0.80 mm.; breadth 0.50-0.65 mm.; thickness 0.18-0.25 mm.

Holotype (Cushman Coll. No. 57878) from the Miocene, Charapoto formation, south of the Caraquez Bay area, 8750 meters northeast of the village of La Punta on the Pacific Coast, Ecuador (sample 21818). It is common at the type locality and also occurs at localities 21740, 21746, 21747, 21748, and 21860.

It differs from *P. charapotoensis* n. sp. in the thicker test, fewer and more inflated chambers, and less acute periphery.

Genus **CIBICIDES** Montfort, 1808

**CIBICIDES ISIDROENSIS** Cushman and Renz (Pl. 10, figs. 30, 31)

*Cibicides isidroensis* CUSHMAN and RENZ, Contr. Cushman Lab. Foram. Res., vol. 17, 1941, p. 26, pl. 4, fig. 10.—RENZ, Proc. 8th Amer. Sci. Congress, 1942, p. 556 (list).—CUSHMAN and ELLISOR, Journ. Pal., vol. 19, 1945, p. 571, pl. 78, fig. 9.

This species, described from the Miocene Agua Salada formation of Venezuela, is recorded from the Brasso formation of Trinidad and the Anahuac formation of Texas. It was found in samples 21749, 21818, and 21860.

### 317. SOME PALEOCENE FORAMINIFERA FROM THE MADRUGA FORMATION OF CUBA

BY JOSEPH A. CUSHMAN and PEDRO J. BERMUDEZ

Outcrops with typically Paleocene faunas have been observed in various parts of Cuba. The shales, sandy shales, and fine radiolarian sandstones, named Madruga formation, are well exposed in the vicinity of Madruga village and in other localities in the provinces of Pinar del Rio, Habana, and Oriente. In Las Villas and Camagüey provinces the Paleocene consists of a very hard, white, dense, and compact limestone with a fauna of shallow water facies predominating, such as some species of *Borelis* (*B. jamaicensis* Vaughan, *B. gunteri* Cole, *B. matleyi* Vaughan) and some unidentified species of *Textularia*, *Cuneolina*, *Lockhartia*, and the Miliolidae. This hard limestone is named Remedios limestone and is very similar to the Cedar Keys limestone of Florida (Cole, Florida Dept. Conservation, Geol. Bull. 26, 1944, pp. 27, 28) and is apparently in part equivalent to the Madruga formation. Both the Madruga formation and the Remedios limestone are Midwayan in age. They are being formally described by the junior author in an article to be published soon: "Contribution al Estudio del Cenozoico Cubano."

The species here recorded originate from the Madruga formation at two localities as follows:

Bermudez sta. 76b: Under highway bridge on Central San Antonio,  
Madruga, Habana Province, Cuba.

Bermudez sta. C-24: San Juan y Martinez, Pinar del Rio Province,  
Cuba.

We are indebted to Caridad V. Bermudez, wife of the junior author, who made the drawings illustrating the species.

#### Family VALVULINIDAE

Genus *VALVULAMMINA* Cushman, 1933

*VALVULAMMINA NASSAUENSIS* Apolin and Jordan,

var. *CUBANA* Cushman and Bermudez, n. var. (Pl. 11, fig. 1)

Variety differing from the typical form in the larger size, more taper-

ing form and more pointed initial end. Length of holotype 1.17 mm.; breadth 0.87 mm.

Holotype of variety (Cushman Coll. No. 57966) from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

### Family LAGENIDAE

#### Genus MARGINULINA d'Orbigny, 1826

**MARGINULINA DISTINCTA** Cushman and Bermudez, n. sp. (Pl. 11, fig. 2)

Test elongate, early portion close coiled, becoming uncoiled in the adult portion, axis slightly curved, early portion somewhat compressed, adult portion circular in transverse section; chambers distinct, early ones not inflated, adult ones distinctly inflated, increasing in size rapidly as added, the last three making up a large proportion of the test; sutures distinct, earlier ones slightly raised, later ones depressed; wall ornamented with numerous, fine, longitudinal costae, those of the later portion independent of the sutures; aperture radiate, at the peripheral angle, somewhat projecting. Length of holotype 0.80 mm.; diameter 0.30 mm.

Holotype (Cushman Coll. No. 57967) from the Paleocene, Madruga formation, highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

This species differs from *M. havanensis* Cushman and Bermudez in the shorter and stouter form, more strongly oblique sutures, and the costate ornamentation.

#### MARGINULINA TUBERCULATA (Plummer) (Pl. 11, fig. 5)

*Cristellaria subaculeata* CUSHMAN, var. *tuberculata* PLUMMER, Univ. Texas Bull. 2644, 1926 (1927), p. 101, pl. 7, fig. 2; pl. 14, fig. 1.

*Hemicristellaria subaculeata* CUSHMAN, var. *tuberculata* KLINE, Bull. 53, Mississippi State Geol. Survey, 1943, p. 22, pl. 1, fig. 11.

The types of this species are from the Paleocene, Mexia clay of Texas and it is recorded from the Paleocene, Porters Creek clay, of Mississippi. Specimens occur in the Madruga formation, San Juan y Martinez, Pinar del Rio Province, Cuba.

#### Genus DENTALINA d'Orbigny, 1826

**DENTALINA GARDNERAE** (Plummer) (Pl. 11, fig. 3)

*Marginulina gardnerae* PLUMMER, Univ. Texas Bull. 2644, 1926 (1927), p. 106, pl. 5, fig. 11.

*Dentalina (?) gardnerae* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 57, pl. 10, figs. 10-12.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 585, pl. 79, fig. 15.—CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 29, pl. 5, figs. 11, 12.—KLINE, Bull. 53, Mississippi State Geol. Survey, 1943, p. 26, pl. 2, fig. 14.—CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 22, 1946, p. 50, pl. 8, fig. 18.

The types of this species are from the Paleocene of Texas and it is widely recorded in the Paleocene. Typical specimens occur in the Madruga formation of Cuba.

Genus PSEUDOGLANDULINA Cushman, 1929

PSEUDOGLANDULINA MADRUGAENSIS Cushman and Bermudez, n. sp. (Pl. 11, fig. 7)

Test elongate, circular in transverse section, rectilinear; chambers distinct, inflated, increasing very gradually in size as added; sutures distinct, depressed; wall ornamented with very fine longitudinal costae; aperture terminal, radiate. Length of holotype 1.05 mm.; diameter 0.40 mm.

Holotype (Cushman Coll. No. 57968) from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

This species differs from *P. manifesta* (Reuss) in the slightly higher chambers, deeper sutures, and finely costate surface.

Genus VAGINULINA d'Orbigny, 1826

VAGINULINA LONGIFORMA (Plummer) (Pl. 11, fig. 4)

*Cristellaria longiforma* PLUMMER, Univ. Texas Bull. 2644, 1926 (1927), p. 102, pl. 13, fig. 4.

*Hemicristellaria longiforma* PLUMMER, I. c., Bull. 3201, 1933, pp. 54, 61, 62, 64 (lists).  
*Vaginulina longiforma* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 20, 1944, p. 38, pl. 6, figs. 11-13.—CUSHMAN and TODD, I. c., vol. 22, 1946, p. 54, pl. 9, figs. 13, 14.

This is a good index fossil for the Paleocene and has been recorded from Texas, Arkansas, and Alabama. Typical specimens occur in the Paleocene, Madruga formation, of Cuba.

VAGINULINA SEMILAEVIS Cushman and Bermudez, n. sp. (Pl. 11, fig. 6)

Test elongate, somewhat compressed, slender, increasing in width to the last-formed chamber, initial end acute with a slight spine, periphery slightly rounded; chambers of the early portion rather indistinct, later ones distinct and very slightly inflated, increasing rather evenly in size as added; sutures of the early portion indistinct, later ones distinct and slightly depressed, strongly oblique; wall of the early portion nearly smooth, later portion with longitudinal costae independent of the sutures; aperture terminal, radiate. Length of holotype 2.30 mm.; breadth 0.30 mm.

Holotype (Cushman Coll. No. 57988) from the Paleocene, Madruga formation, San Juan y Martinez, Pinar del Rio Province, Cuba.

This species differs from *V. plumoides* Plummer in the more slender, elongate form, higher chambers, and smooth early portion.

## Family POLYMORPHINIDAE

Genus **BULLOPORA** Quenstedt, 1856**BULLOPORA CHAPMANI** (Plummer) (Pl. 11, fig. 8)*Vitrewebbina chapmani* PLUMMER, Univ. Texas Bull. 2644, 1926 (1927), p. 128, pl. 8, fig. 2.*Bullopora chapmani* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 64, pl. 11, figs. 10, 11.—KLINE, Bull. 53, Mississippi State Geol. Survey, 1943, p. 42, pl. 4, fig. 11.—CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 22, 1946, p. 58, pl. 10, figs. 13, 14.

This species is known from the Paleocene of Texas, Arkansas, Mississippi, and Alabama. Specimens occur in the Paleocene, Madruga formation, of Cuba.

## Family HETEROHELICIDAE

Genus **SIPHOCENERINOIDES** Cushman, 1927**SIPHOCENERINOIDES ELEGANTA** (Plummer) (Pl. 11, fig. 9)

(For references, see these Contributions, vol. 22, 1946, p. 59, pl. 10, fig. 18.)

This species seems to be an index fossil for the Paleocene, occurring in Texas, Arkansas, Illinois, Alabama, and Trinidad. Typical specimens occur in the Madruga formation of Cuba.

## Family BULIMINIDAE

Genus **LOXOSTOMUM** Ehrenberg, 1854**LOXOSTOMUM APPLINAE** (Plummer) (Pl. 11, fig. 10)

(For references, see these Contributions, vol. 22, 1946, p. 60, pl. 10, fig. 22.)

This species is known from the Paleocene of Texas and Arkansas. Specimens from other Cretaceous and Tertiary records do not seem to be identical. Rather typical specimens occur in the Paleocene, Madruga formation, of Cuba.

## Family ROTALIIDAE

Genus **EAPONIDES** Montfort, 1808**EAPONIDES VANBELLENI** (van den Bold) (Pl. 12, figs. 1-3)*Cibicides vanbelleni* VAN DEN BOLD, Thesis Univ. Utrecht, Amsterdam, 1946, p. 125, pl. 18, fig. 8.

This species was described from the lower Eocene of Guatemala and British Honduras. Specimens from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba, seem to be identical and indicate that, from the position of the aperture, the species should be placed in *Eponides*.

**EAPONIDES GRATIOSUS** Cushman and Bermudez, n. sp. (Pl. 11, fig. 14)

Test trochoid, unequally biconvex, the ventral side very strongly convex, dorsal side much less so, periphery acute; chambers fairly distinct on the ventral side, those of the last-formed whorl on the dorsal side fairly distinct, earlier whorls obscured by the surface ornamentation; sutures

mostly indistinct, ventrally slightly curved, dorsally strongly oblique; wall of the ventral side somewhat roughened but not definitely papillate, dorsal side finely but distinctly papillate except over the last few chambers which are fairly smooth; aperture ventral, a low elongate opening at the margin of the last-formed chamber. Diameter of holotype 0.63 mm.; thickness 0.38 mm.

Holotype (Cushman Coll. No. 57970) from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

The species differs from *E. vanbelleni* (van den Bold) in the acute periphery, smoother ventral side, and nearly straight ventral sides in edge view.

#### Genus VALVULINERIA Cushman, 1926

**VALVULINERIA EXTENSA** Cushman and Bermudez, n. sp. (Pl. 12, figs. 7-9)

Test trochoid, the dorsal side very slightly convex, ventral side increasing rapidly in thickness in the adult, periphery subacute to slightly rounded; chambers distinct, numerous, 10 or more in the adult whorl, increasing very gradually in size as added, with a ventral lobe over the umbilical area in the early stages becoming high and extending outward in the later portion; sutures distinct, slightly depressed, curved; wall smooth, distinctly perforate; aperture extending from the periphery along the ventral margin of the last-formed chamber. Length 0.45-0.50 mm.; breadth 0.35-0.40 mm.; thickness 0.28-0.32 mm.

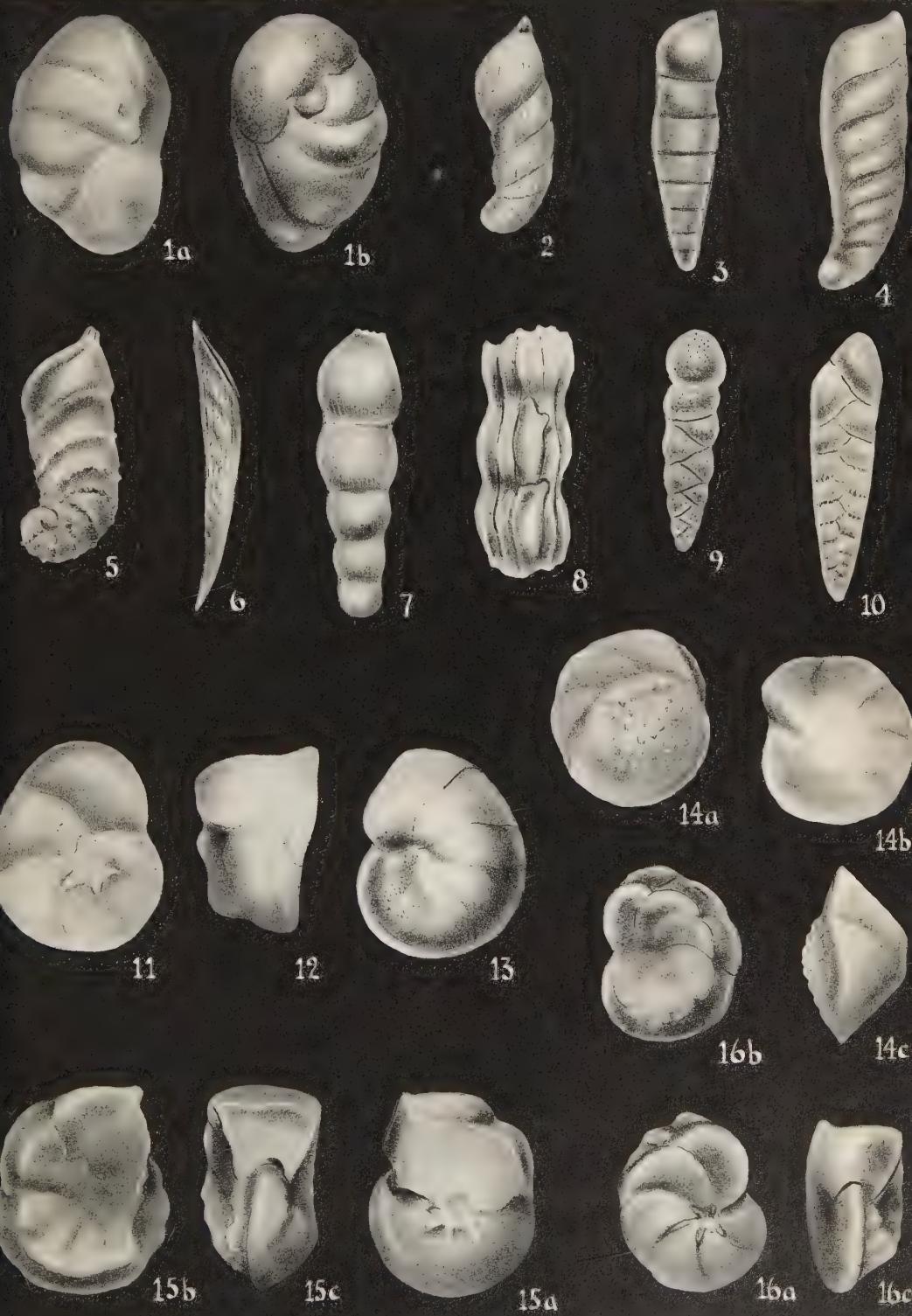
Holotype (Cushman Coll. No. 57971) from the Paleocene, Madruga formation, under highway bridge, Central San Antonio, Madruga, Habana Province, Cuba.

This species differs from *V. herricki* (Hadley) in the larger number of chambers, more concave periphery, and more open umbilical region.

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#### EXPLANATION OF PLATE 11

FIG. 1. *Valvulammina nassauensis* Applin and Jordan, var. *cubana* Cushman and Bermudez, n. var.  $\times 30$ . Holotype. *a*, dorsal view; *b*, ventral view. 2. *Marginulina disincta* Cushman and Bermudez, n. sp.  $\times 40$ . Holotype. 3. *Dentalina gardnerae* (Plummer).  $\times 40$ . 4. *Vaginulina longiforma* (Plummer).  $\times 30$ . 5. *Marginulina tuberculata* (Plummer).  $\times 30$ . 6. *Vaginulina semilaevis* Cushman and Bermudez, n. sp.  $\times 18$ . Holotype. 7. *Pseudoglandulina madrugaensis* Cushman and Bermudez, n. sp.  $\times 30$ . Holotype. 8. *Bullopora chapmani* (Plummer).  $\times 18$ . Specimen attached to *Nodosaria*. 9. *Siphogenerinoides elegans* (Plummer).  $\times 100$ . 10. *Loxostomum applinae* (Plummer).  $\times 55$ . 11-13. *Boldia carinata* Cushman and Bermudez, n. sp.  $\times 65$ . 11, 12, Paratypes. 13, Holotype. 11, Dorsal view. 12, Peripheral view. 13, Ventral view. 14. *Eponides gratiosus* Cushman and Bermudez, n. sp.  $\times 40$ . Holotype. *a*, dorsal view; *b*, ventral view; *c*, peripheral view. 15, 16. *Boldia cubensis* Cushman and Bermudez, n. sp.  $\times 40$ . 15, Holotype. 16, Paratype. *a*, *a*, dorsal views; *b*, *b*, ventral views; *c*, *c*, peripheral views.





**VALVULINERIA MADRUGAENSIS Cushman and Bermudez, n. sp.** (Pl. 12, fig. 10)

Test trochoid, with the dorsal side much less convex than the ventral, periphery rounded, becoming more acute in the later portion; chambers distinct in the later portion, slightly inflated, numerous, earlier ones indistinct, not inflated, increasing very gradually in size as added, with a narrow, ventral lobe over the umbilical area; sutures distinct in the later portion and slightly depressed, earlier ones indistinct; wall smooth; aperture extending from the periphery along the ventral margin of the last-formed chamber. Length of holotype 0.65 mm.; breadth 0.50 mm.; thickness 0.35 mm.

Holotype (Cushman Coll. No. 57973) from the Paleocene, Madruga formation, under highway bridge, Central San Antonio, Madruga, Habana Province, Cuba.

This species differs from *V. extensa* n. sp. in the somewhat larger size, tendency for the last-formed chambers to not reach the periphery on the dorsal side, and the less projecting ventral lobe.

**Genus PSEUDOPARRELLA Cushman and ten Dam, 1948****PSEUDOPARRELLA MADRUGAENSIS Cushman and Bermudez, n. sp.** (Pl. 12, figs. 11-13)

Test trochoid, nearly equally biconvex, ventral side slightly more convex, periphery acute, slightly keeled; chambers distinct, very slightly inflated, about 5 in the adult whorl, increasing rather evenly in size as added; sutures distinct, dorsally strongly curved, ventrally nearly radial; wall smooth, distinctly perforate; aperture at the ventral margin of the last-formed chamber and extending outward parallel to the periphery, narrow and with a distinct lip. Diameter 0.35-0.40 mm.; thickness 0.15-0.18 mm.

Holotype (Cushman Coll. No. 57974) from the Paleocene, Madruga formation, under highway bridge, Central San Antonio, Habana Province, Cuba.

This species differs from *P. obtusa* (Burrows and Holland) in the definite keel, curved dorsal sutures, and less extended aperture.

## EXPLANATION OF PLATE 12

Figs. 1-3. *Eponides vanbelleni* (van den Bold).  $\times 40$ . 1, Ventral view. 2, Peripheral view. 3, Dorsal view. 4-6. *Boldia madrugaensis* Cushman and Bermudez, n. sp.  $\times 40$ . 5, Holotype. 4, 6, Paratypes. 4, Ventral view. 5, Dorsal view. 6, Peripheral view. 7-9. *Valvulineria extensa* Cushman and Bermudez, n. sp.  $\times 65$ . 7, Holotype. 8, 9, Paratypes. 7, Ventral view. 8, Peripheral view. 9, Dorsal view. 10. *V. madrugaensis* Cushman and Bermudez, n. sp.  $\times 40$ . Holotype. a, dorsal view; b, ventral view; c, peripheral view. 11-13. *Pseudoparella madrugaensis* Cushman and Bermudez, n. sp.  $\times 90$ . 12, Holotype. 11, 13, Paratypes. 11, Dorsal view. 12, Peripheral view. 13, Ventral view. 14-16. *Anomalina martinezensis* Cushman and Bermudez, n. sp.  $\times 40$ . 14, Holotype. 15, 16, Paratypes. 14, Dorsal view. 15, Peripheral view. 16, Ventral view. 17. *A. clementiana* (d'Orbigny), var. *assimilis* Cushman and Bermudez, n. var.  $\times 60$ . Holotype. a, dorsal view; b, ventral view; c, peripheral view.

## Family ANOMALINIDAE

## Genus ANOMALINA d'Orbigny, 1826

**ANOMALINA MARTINEZENSIS** Cushman and Bermudez, n. sp. (Pl. 12, figs. 14-16)

Test trochoid, biconvex, both dorsal and ventral sides depressed in the median portion, periphery broadly rounded, tending to become slightly angular in the adult; chambers distinct, somewhat inflated, about 8 in the adult whorl, increasing very gradually in size as added; sutures distinct, limbate and slightly raised, dorsally oblique and somewhat curved, ventrally nearly radial; wall very coarsely perforate; aperture at the peripheral margin extending onto the ventral side at the base of the last-formed chamber, with a distinct lip. Diameter 0.65-0.80 mm.; thickness 0.32-0.40 mm.

Holotype (Cushman Coll. No. 57992) from the Paleocene, San Juan y Martinez, Pinar del Rio Province, Cuba.

This species resembles *A. midwayensis* (Plummer) but differs in the more coarsely perforate wall, larger size, and much rougher surface. It also resembles *Cibicides vulgaris* (Plummer).

**ANOMALINA CLEMENTIANA** (d'Orbigny), var. **ASSIMILIS** Cushman and Bermudez, n. var.  
(Pl. 12, fig. 17)

Variety differing from the typical form in the slightly narrower chambers and slightly thicker test.

Holotype of variety (Cushman Coll. No. 57977) from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

This variety is very closely related to this Upper Cretaceous species.

## Genus BOLDIA van Bellen, 1946

**BOLDIA CUBENSIS** Cushman and Bermudez, n. sp. (Pl. 11, figs. 15, 16)

Test in the early stages trochoid, in the adult becoming nearly planispiral, periphery in the adult becoming truncate, earlier portion with a narrowly rounded border, both dorsal and ventral sides somewhat concave; chambers fairly distinct, about 6 in the adult whorl, slightly inflated, increasing very gradually in size as added; sutures rather indistinct, curved, little if at all depressed; wall smooth except for the umbilical area of the dorsal side which has a stellate thickening; aperture a low opening at the peripheral margin, extending over on the dorsal side, with a slight lip. Diameter of holotype 0.70 mm.; thickness 0.45 mm.

Holotype (Cushman Coll. No. 57978) from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

The species differs from *B. vandersluisi* van den Bold in the smaller

size, less truncate periphery, and the more curved sutures. The original description of the genus gives the aperture as ventral but in this and the following species it is largely peripheral.

**BOLDIA MADRUGAENSIS Cushman and Bermudez, n. sp.** (Pl. 12, figs. 4-6)

Test trochoid in the young, nearly planispiral in the adult, periphery in the adult becoming somewhat truncate in the last portion, earlier portion rounded, both dorsal and ventral sides somewhat concave, ventral side somewhat umbilicate; chambers fairly distinct, 7 or 8 in the adult whorl, distinctly inflated on the ventral side; sutures distinct and depressed ventrally, slightly curved, nearly radial, dorsally indistinct; wall coarsely perforate, smooth on the ventral side, dorsal side with numerous irregular raised portions radiating out toward the periphery; aperture peripheral and extending over onto the dorsal side as a narrow slit at the inner margin of the last-formed chamber with a distinct lip. Diameter 0.45-0.65 mm.; thickness 0.30-0.45 mm.

Holotype (Cushman Coll. No. 57981) from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

This species differs from *B. vandersluisi* van den Bold in the much smaller size, less truncate border, umbilicate ventral side, and irregularly papillate dorsal side.

**BOLDIA CARINATA Cushman and Bermudez, n. sp.** (Pl. 11, figs. 11-13)

Test trochoid in the early stages, becoming planispiral in the adult, periphery in the adult truncate with a median depression, the dorsal angle carinate, both dorsal and ventral sides concave in the adult, ventral side somewhat umbilicate; chambers fairly distinct, inflated ventrally, very slightly so dorsally, usually 8 chambers in the adult whorl; sutures indistinct dorsally, ventrally distinct and depressed, somewhat sinuous; wall coarsely perforate, slightly roughened, not papillate, dorsal side with a slight stellate appearance due to the lip above the aperture; aperture extending from the periphery along the dorsal margin of the last-formed chamber, with a slight lip. Diameter 0.50-0.60 mm.; thickness 0.38-0.43 mm.

Holotype (Cushman Coll. No. 57982) from the Paleocene, Madruga formation, under highway bridge, Central San Antonio, Habana Province, Cuba.

This species differs from *B. vandersluisi* van den Bold in the smaller size, more definitely keeled and more concave periphery.

318. THREE NEW NAMES  
FOR RECENT PACIFIC FORAMINIFERA

BY JOSEPH A. CUSHMAN and IRENE McCULLOCH

Dr. Hans E. Thalmann has kindly called to our attention the fact that three of the names proposed in our paper, "A Report on Some Arenaceous Foraminifera" (Allan Hancock Pacific Exped., vol. 6, No. 1, 1939, pp. 1-113, pls. 1-12), are preoccupied. We propose the following new names to replace them:

**Proteonina hancocki** Cushman and McCulloch, new name, for *Proteonina compressa* Cushman and McCulloch (not Paalzow, 1932), Allan Hancock Pacific Exped., vol. 6, No. 1, 1939, p. 42, pl. 1, fig. 10.

**Labrospira columbiensis** (Cushman), var. **robusta** Cushman and McCulloch, new name, for *Haplophragmoides columbiense* Cushman, var. *evolutum* Cushman and McCulloch (not Natland, 1938), Allan Hancock Pacific Exped., vol. 6, No. 1, 1939, p. 73, pl. 5, figs. 11, 12; pl. 6, figs. 1, 2.

**Trochammina pacifica** Cushman, var. **simplissima** Cushman and McCulloch, new name, for *Trochammina pacifica* Cushman, var. *simplex* Cushman and McCulloch (not Friedburg, 1902), Allan Hancock Pacific Exped., vol. 6, No. 1, 1939, p. 104, pl. 11, fig. 4.

319. ANOMALINA TENUISSIMA (REUSS),  
VAR. EVOLUTA VAN BELLEN, A HOMONYMBY DR. R. C. VAN BELLEN,  
Syria Petroleum Company, Aleppo, Syria

Dr. H. E. Thalmann drew my attention to a homonym in one of my publications. Quoting part of his letter on this subject:

"*Anomalina tenuissima* (Reuss), var. *evoluta* van Bellen 1941, Proc. Nederl. Akad. Wetensch., vol. 44, p. 1001, pl. fig. 25, from the Dalmatian Eocene, is preoccupied by *Anomalina variolata* d'Orbigny, var. *evoluta* Walther 1888, Mitt. Zool. Station Neapel, Bd. 8, p. 382, pl. 20, fig. 3, a recent form from the Gulf of Naples, Italy."

I wish to change this name into *Anomalina tenuissima* (Reuss), var. *jongmansii* van Bellen, in honor of Prof. Dr. W. J. Jongmans, former Director of the Geological Department of the Dutch State Collieries,

Heerlen, Holland, who assisted me by all possible means during my work for my thesis in that Department.

I gratefully acknowledge Dr. Thalmann's assistance in helping all of us in clearing up the foraminiferal nomenclature.

Aleppo

July 30, 1948.

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*Erratum* In the preceding issue of these Contributions, on page 46, the word *kattagatensis* should read *kattegatensis*.

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## RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the foraminifera that have come to hand:

**Almela, A. and J. M. Rios.** Una Nueva Especie de *Discocyclina* del Eoceno Catalán.—Notas y Comunicaciones Institut. Geol. Min. España, No. 10, 1942, pp. 1-8, 4 figs.—*Discocyclina oliana* is described and figured and a list of numerous foraminifera and other fossils is given.

**Rios, J. M. and A. Almela.** Un Chaetetido del Eoceno Español.—L. c., No. 12, 1943, pp. 1-19, 11 figs.—Lists are given of some of the larger foraminifera.

**Grekoff, N.** Répartition Stratigraphique du Genre *Arenobulimina* Cushman.—Revue Institut. Français Pétrole et Annales des Combustibles liquides, vol. II, No. 10, Oct. 1947, pp. 491-509, pls. I, II, 3 text figs., 2 tables, 2 charts.—Descriptions and figures are given of the numerous known species and charts of distribution and specific characters.

**Hiltermann, Heinrich.** Fortschritte der stratigraphischen Mikropaläontologie in Deutschland.—Jahresbericht Nat. Gesell. Hannover, 1942/43-1946/47 (1947), pp. 7-33, 8 tables.—The tables, some with figures, show the stratigraphic distribution of many species of foraminifera.

**Bursch, Jac. George.** Mikropaläontologische Untersuchungen des Tertiärs von Gross Kei (Molukken).—Schweizerischen Paläontologischen Abhandlungen, vol. 65, 1947, pp. 1-69, pls. 1-5, 1 table, text figs. 1-22.—Numerous species, mostly large foraminifera, are described and figured, many new.

**Cushman, Joseph A. and Roscoe E. and Katherine C. Stewart.** Five Papers on Foraminifera from the Tertiary of Western Oregon.—State of Oregon, Dept. Geol. & Min. Industries, Bull. 36, pts. I-V, July 1947 [May 28, 1948], pp. 1-11, pls. 1-13, 4 text figs.

Part I, Astoria Miocene Foraminifera from the Northwest Corner of Tenth Street and Harrison Avenue, Astoria, Clatsop County, Oregon.—pp. 9-39, pls. 1-4.—

Numerous species recorded and figured, the following new: *Angulogerina astoriensis* n. sp. and *Planulina astoriensis* n. sp.

Part II, Astoria Miocene Foraminifera from Agate Beach, Lincoln County, Oregon.—pp. 41-55, pls. 5, 6.—Numerous species recorded and figured, the following new: *Bolivina astoriensis* n. sp. and *Eponides mansfieldi* Cushman, var. *oregonensis* n. var.

Part III, Upper Coaledo (Upper Eocene) Foraminifera from Yokam Point, Coos County, Oregon.—pp. 57-69, pls. 7, 8.—Numerous species recorded and figured, none new.

Part IV, Lower Coaledo (Upper Eocene) Foraminifera from Sunset Bay, Coos County Oregon.—pp. 71-91, pls. 9-11.—Numerous species recorded and figured, the following new: *Plectofrondicularia searsi* n. sp.

Part V, Eocene Foraminifera from Helmick Hill, Polk County, Oregon.—pp. 93-111, pls. 12, 13.—Numerous species recorded and figured, the following new: *Plectofrondicularia oregonensis* n. sp., *Globobulimina pacifica* Cushman, var. *oregonensis* n. var., and *Cibicides warreni* n. sp.

**Senn, Alfred.** Die Geologie der Insel Barbados B.W.I. (Kleine Antillen) und die Morphogenese der umliegenden marinen Grossformen.—Eclogae Geol. Helvetiae, vol. 40, No. 2, May 31, 1948, pp. 199-222, chart, map.—The various formations are described and their ecology discussed and a chart given showing the stratigraphy. A few foraminifera are mentioned.

**Dorreen, J. M.** A foraminiferal fauna from the Kaiatan stage (upper Eocene) of New Zealand.—Journ. Pal., vol. 22, No. 3, May 1948, pp. 281-300, pls. 36-41, 2 text figs. (maps), 2 tables.—The new genera, *Nummulitella* (genotype *N. polystylata* n. sp.), *Glabratella* (genotype *G. crassa* n. sp.), and *Stomatorbina* (genotype *Lamarckina torrei* Cushman and Bermudez) are erected and 21 new species and 2 new varieties described.

**Frizzell, Don L.** Orthography and type designation of *Dictyoconus* Blanckenhorn (Foraminifera).—L. c., pp. 370, 371.—Gives a discussion of the spelling and type designation of the genus.

**Caudri, C. M. Bramine.** Note on the Stratigraphic Distribution of *Lepidorbitoides*.—L. c., No. 4, July 1948, pp. 473-481, pls. 73, 74.—Numerous lists of species are given and the vertical range of *Lepidorbitoides* is discussed. A new genus, *Bontourina*, is proposed to replace the invalid name of *Hexagonocyclina* with a new type species, *B. inflata* n. sp.

**ten Dam, Abraham.** *Cribroparella*, a new genus of Foraminifera from the Upper Miocene of Algeria.—L. c., pp. 486, 487, pl. 76 (part).—*Cribroparella* (genotype *C. regadana* n. sp.) is erected.

**LeRoy, L. W.** The Foraminifer *Orbulina universa* d'Orbigny, a suggested middle Tertiary time indicator.—L. c., pp. 500-508, 4 text figs.

**Hofker, J.** On *Asterigerina gürichi* (Franke) and Remarks on Polymorphism and the Stratigraphic Use of Foraminifera.—L. c., pp. 509-517, 6 text figs.

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van Voorthuysen, J. H. Upper Cretaceous Foraminifera of minute size in the Marine Pleistocene (Icenan) sands of the Netherlands.—L. c., pp. 525-527, 2 text figs.

Grimsdale, T. F. Occurrence of *Lepidocyclina pustulosa* (H. Douvillé) in Morocco.—L. c., pp. 529, 530.

Wood, Alan. Sectioning Small Foraminifera.—L. c., p. 530.

Stainforth, R. M. Description, Correlation, and Paleoecology of Tertiary Cipero Marl Formation, Trinidad, B.W.I.—Bull. Amer. Assoc. Petr. Geol., vol. 32, No. 7, July 1948, pp. 1292-1330, 2 text figs.—Many lists of foraminifera are given.

Williams-Mitchell, E. The Zonal Value of Foraminifera in the Chalk of England.—Proc. Geol. Assoc., vol. 59, pt. 2, 1948, pp. 91-112, pls. 8-10.—Numerous species are noted and figured, the following new: *Globigerina portsdownensis* n. sp. and *Globorotalia chaldonensis* n. sp. Lists of selected species are given from various zones.

J. A. C.



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